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San Francisco Bay Region

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FROM: Bill Johnson and Richard Looker

DATE: May 18, 2004

SUBJECT: RESPONSES TO SCIENTIFIC PEER REVIEW COMMENTS
SAN FRANCSICO BAY MERCURY TMDL

In October 2003, we completed a draft Basin Plan Amendment and supporting staff report for the San Francisco Bay Mercury TMDL, and provided copies to three scientific peer reviewers: Prof. David Sedlak, Prof. Rhea Williamson, and Prof. James Kirchner.

The reviewer comments focus mainly on the scientific portions of the Basin Plan Amendment and staff report. The intent of the review was to ensure that the proposed amendment is based on sound scientific knowledge, methods, and practices. To help focus the review, we submitted instructions for peer review (see October 24, 2003 transmittal memorandum) to the reviewers along with the material to be reviewed. These instructions included one or more specific technical questions pertaining to each TMDL element (e.g. Numeric Targets, Allocations, etc.) and three additional overarching questions pertaining to the soundness of the TMDL project in general. These three overarching questions and the response (indicated as R1, R2, R3) of each peer reviewer are as follows.

1. Are data used in the report reliable and appropriate, and is the treatment of the data defensible?
2. Does the report as a whole support its scientific conclusions and recommendations?
3. Does the analysis present a sufficiently compelling scientific justification to proceed with the TMDL adoption and implementation plan as proposed?

    a. Professor David Sedlak answered all three questions with this paragraph. *The development of a TMDL for mercury in San Francisco Bay is very challenging and I believe that the authors of the report should be commended for their efforts. In my opinion, the report articulates the state of the science with respect to mercury in San Francisco Bay and the various approaches that can be used to ameliorate the risks that mercury poses to humans and wildlife. The authors have done a good job identifying uncertainties in the data and designing a TMDL that can be adapted as additional information becomes available. Although certain elements of the report could be improved, I believe that the plan should be adopted in a timely manner. The report makes it clear that mercury really is a problem in San Francisco Bay and that a modest allocation of resources can help solve the problem.*

    b. Professor Rhea Williamson provided answers to the first two questions.

R1) *Generally, the data presented are reliable and appropriate. Some applications of data are questioned. In addition, some parts of the document need a more technical approach.*

R2) *Yes, with some gaps, questionable assumptions.*

c. Professor James Kirchner answered the three questions in turn

R1) *To my knowledge, the data used in the report are the best currently available. There are several important information gaps which are clearly identified in the report. The treatment of the data is appropriate; the report neither over-interprets the available data, nor overlooks important data bearing on the matters of interest.*

R2) *Yes.*

R3) *Yes. The report recognizes that there are key information gaps, but these do not justify indefinite delay in implementing a plan of action. Enough is known about the sources, fate, and effects of mercury in San Francisco Bay to justify the proposed TMDL allocations and the proposed implementation plan. The implementation plan proposed in the report is a reasonable approach to managing mercury in San Francisco Bay, while simultaneously working to fill the critical information gaps, and allows for changes to be made as new information becomes available.*

The specific comments we received from each reviewer expand upon the overarching questions, and these are contained in three separate documents – one for each reviewer. Our responses to - reviewer comments follow.

PROF. DAVID SEDLAK

To organize our responses to Prof. Sedlak's comments, we numbered the comments in his letter and prepared a response to each numbered comment, as listed below.

1. This general comment does not require a response.

2. All scientific papers cited in the report will be included in the administrative record and made available for review at the Water Board offices in Oakland. To aid the reader, we will add some data regarding mercury concentrations in fish tissue and bird eggs to Section 2, Problem Statement.

3. We did not intend to imply that some metals degrade. We will revise the text for clarity.

4. We relied on “Wiener et al.,” not the references cited in “Wiener et al.”; therefore, we cited “Wiener et al.” in the report and will include a copy in the administrative record. At the time we completed the scientific review draft, the version of “Wiener et al.” we had was the version submitted for publication. We have since obtained a copy of the final document published in 2003. We will update our citations to refer to this final version.

5. We will make this editorial change.

6. The shaded areas at the bottom of the boxes in Figures 3.1 and 3.2 are intended to represent the active layer (part of the system, inside the box). However, the arrows representing bed erosion are misplaced. They should originate outside the boxes and move into the shaded areas. We will edit the text for clarity and revise Figures 3.1 and 3.2 to show bed erosion moving sediment into the active layer from below. We will retain the label “net” because, unlike atmospheric deposition and evaporation, which were estimated separately in Section 4, Source Assessment, only the net result of bed burial and erosion is estimated in the text.

7. The suggested edit is unnecessary. The first “is” introduces both adjectives (“commensurate” and “adequate”).

8. Figure 3.1 relates to sediment transport. It excludes some of the mercury sources and losses shown in Figure 3.2 (wastewater, atmospheric deposition, and evaporation) because they are not important means of sediment transport. The sediment sources and losses shown in Figure 3.1 are assumed to be at steady state. The mercury sources and losses shown in Figure 3.2 are not. We will revise the text for clarity.

9. We will revise the text to clarify that dredging and disposal only affect the content of the “box” to the extent that they remove sediment from the top 15 centimeters. The dredging estimates in Section 4, Source Assessment, reflect maintenance dredging, which is relatively shallow.

10. We use suspended sediment mercury concentrations instead of bed sediment concentrations where these data are available to derive loads because such estimates more accurately reflects the mass of mercury entering San Francisco Bay. The particle size distribution of suspended material is likely narrower than that for bed sediment, and therefore, mercury concentrations observed should more accurately reflect the influence of sources rather than changes in particle size (i.e., sandy sediment typically contains less mercury). By using suspended sediment mercury concentrations to estimate the total mass of mercury in the bay, we may be providing an upper bound estimate for that quantity. However, the suspended sediment mercury concentrations agree well when compared to bed sediment mercury concentrations normalized to the fraction of fine material. The mean and median of suspended sediment mercury concentrations are 0.43 and 0.33 mg/kg, compared to a mean and median of bed sediment mercury concentrations of 0.44 and 0.37 mg/kg. When we track trends in sediment concentrations, we will be comparing mercury concentrations

on suspended sediment in the future to current levels. If we need to compare mercury concentrations on suspended sediment to mercury concentrations in bed sediment, we will be careful about taking into consideration the fraction of fine material in the bed sediment prior to making the comparison.

11. Many of the load estimates provided in Section 4, Source Assessment, were based on estimated sediment mercury concentrations and estimated sediment loads (Equation 1). The Central Valley watershed load was an exception. The San Francisco Estuary Institute (SFEI) estimated the average annual mercury load by using a regression of total mercury concentrations in water versus total suspended sediment concentrations in water. This method does not involve estimating sediment mercury concentrations. However, the effective average sediment mercury concentration can be deduced from the average mercury load and the average suspended sediment load. We will revise the text to clarify how SFEI arrived at its mercury load estimate and include the SFEI reference in the administrative record.

12. A flow volume weighted mean sediment mercury concentration for urban runoff would be ideal. However, such information is unavailable. Our calculation is based on bed sediment mercury concentrations. We do not know how flow magnitudes affect sediment concentrations flowing into San Francisco Bay.

13. The discrepancy is due to rounding. As explained in the note below Table 4.1, we rounded most mercury and sediment concentration and load estimates to two significant digits. Our intent was to avoid implying an unwarranted level of certainty in our estimates. However, we completed all calculations prior to rounding. In this case, we subtracted 35.87 M kg/yr from 44.36 M kg/yr and rounded the result, 8.49 M kg/yr, to two significant digits. We will add a statement about rounding to the text, in addition to the table notes.

14. Remediation has begun at the U.C. Berkeley Richmond Field Station. The data in Table 4.6 represent conditions prior to starting the cleanup and are presented only for informational purposes. Remediation has not begun at the Zeneca-Stege Marsh site.

15. The proposed fish tissue target applies to the average mercury concentration in a collection of fish representing typical human consumption. Figure 5.1 shows median mercury concentrations in tissue from several fish species. However, it does not show the average mercury concentration in fish representing a typical human diet. The relative proportion of fish species typically consumed is unknown. We do know that most fish consumers report eating striped bass. Therefore, we have targeted striped bass as a key species to use to evaluate trends and compliance with the fish tissue target. We estimate that the reduction needed to meet the target is roughly equal to the reduction needed to reduce the mean mercury concentration in striped bass to the target (about 40%). We used this value to derive the sediment target. (In response to other comments we received, we will revise Figure 5.1 to show mean concentrations, not medians.)

Section 8, Implementation Plan, describes the method we propose to use to evaluate progress toward meeting the fish tissue target. We propose that at least 15 small and 15 medium striped bass be collected. Based on a linear fit of the data, we will compare the concentration representing a fish measuring 60 centimeters to the target.

16. We will clarify in the text that the sediment target is a target for the mercury concentration on suspended sediment.

17. We agree that the fish tissue target should reflect the typical diet of consumers of bay fish. We discuss how the fish tissue target will be evaluated in Section 8, Implementation Plan. However, the comment regarding page 36 appears to refer to concerns about the median suspended sediment concentration, not fish tissue concentration. We will change the text to say that the median is the preferred measure of central tendency because it is less sensitive to the extreme values of the skewed distribution (see Figure A below). We analyzed the shape of this distribution and found it to be somewhat, but not perfectly lognormal (see Figure B below). Based on the fact that the distribution of suspended sediment concentrations was definitely not normal and not unambiguously lognormal, we chose the median of the original distribution as the central tendency to use in our report.

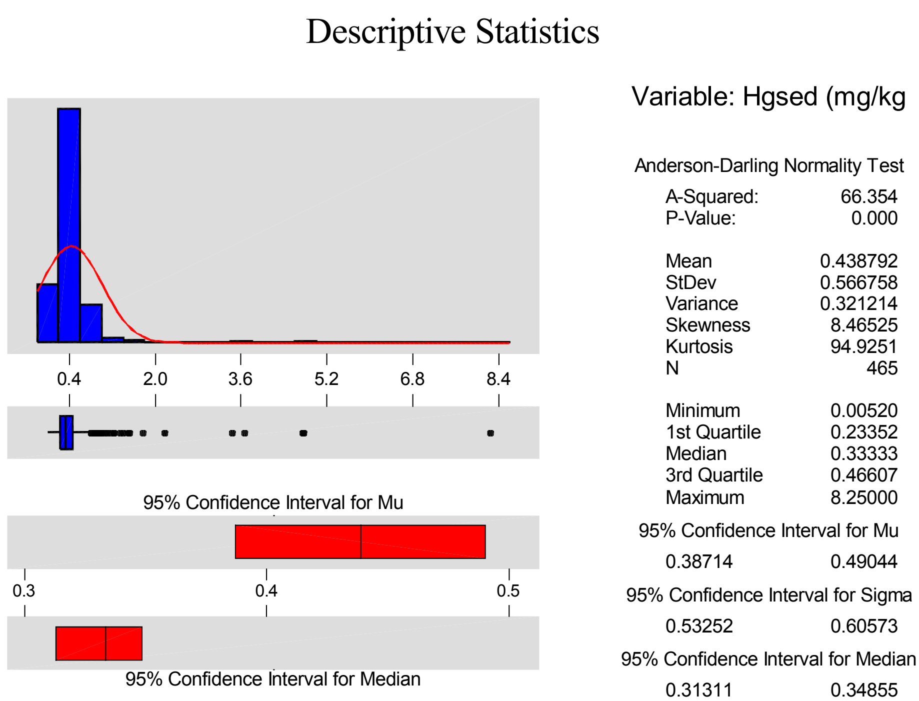

Figure A – Descriptive Statistics of the Distribution of Suspended Sediment Concentrations

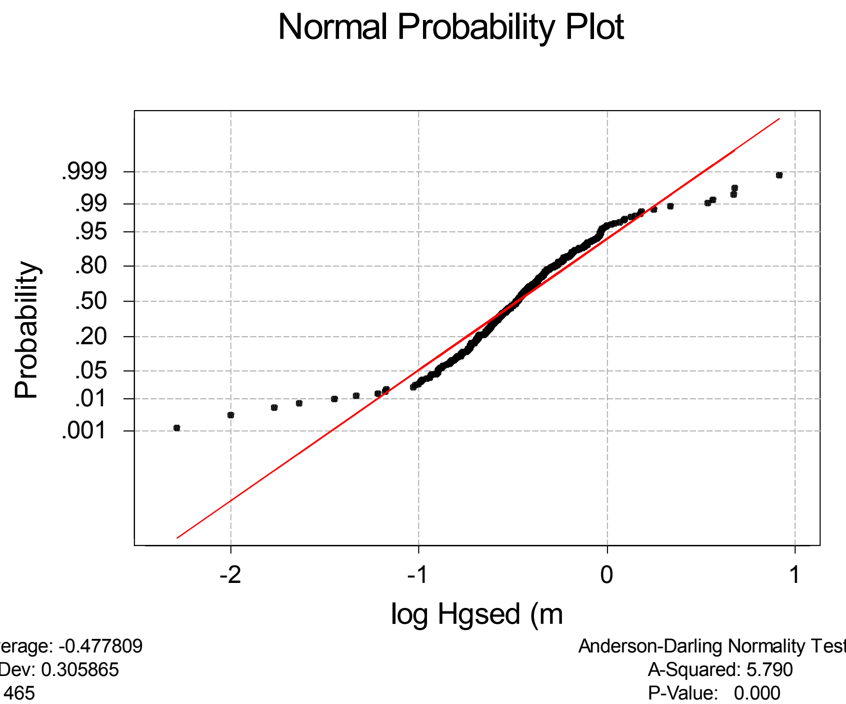

Figure B – Normal Probability Plot of the Suspended Sediment Concentration Data

18. We recently performed additional analysis of San Francisco Bay continuous suspended-sediment concentration data collected by the U.S. Geological Survey (USGS) and found that the Basin Plan objective may be exceeded about 8% of the time when the sediment target is achieved. We will add some text in the report summarizing the results of the analysis.

19. We will correct the figure label.

20. We agree that assessing TMDL compliance throughout San Francisco Bay presents some difficulties. The targets should not only be met in San Francisco Bay as a whole, but also at all locations within San Francisco Bay. To assess the compliance of the bay as a whole will require collection of data from many different representative locations throughout the bay. The implementation plan is intended to be flexible enough to help us achieve this goal. We expect that the Regional Monitoring Program (RMP) and other monitoring efforts will continue to further our understanding on how biota and sediment concentrations within the various segments of San Francisco Bay are responding to management efforts. This should allow us to focus actions on certain segments of the bay where they are most needed. For example, we are dealing with local problems in Lower South San Francisco Bay through the Guadalupe River Mercury TMDL. We will continue

to be involved in the RMP and will advocate that monitoring be performed as suggested in the comment.

21. We will revise the text for clarity as suggested.

22. The U.S. Environmental Protection Agency's (USEPA's) *Mercury Study Report to Congress* uses the notation "K_{db}" and defines this "sediment-to-water partition coefficient" as the "equilibrium concentration in sediment solid divided by the concentration in pore water."

23. We will revise the text to reflect that suspended sediment concentrations in San Francisco Bay are typically around 100 milligrams per liter, and at this concentration, assuming a sediment-to-water partition coefficient of 16,000 to 990,000 milliliters per gram, we estimate that between 62% and 99% of the mercury in San Francisco Bay water is associated with particles.

24. The intent of this paragraph is not to quantify methylmercury concentrations in San Francisco Bay; it is to establish a link between the mercury sources and the proposed targets. Nevertheless, we will revise the text to add some methylmercury data.

25. We will make these editorial changes.

26. We chose not to allocate a portion of the TMDL for future growth. The Association of Bay Area Governments' year 2025 growth projections for the Bay Area suggests that there will be modest (~14% region wide) population growth over that period. We believe modest influent flow increases could be offset both by slight improvements in treatment efficiency and increased water re-use; therefore, the mercury allocations will not pose a compliance challenge to wastewater treatment plants or necessitate flow limitations. If growth becomes a concern, for example 15 to 20 years from now, we expect to know more about how our mercury control efforts are working and have a more solid basis for determining if modifications to the wastewater allocations are appropriate.

27. We will modify the text to cite the evidence presented in the Hsu and Sedlak paper.

28. We will modify the figure and companion text as suggested.

29. This general comment does not require a response.

30. We will insert the word "intended" between "is" and "to."

31. The time needed for San Francisco Bay to recover is uncertain. We will change the text to suggest that the period will be roughly 120 years if the TMDL is adopted and implemented.

32. This general comment does not require a response.

33. We are willing to work with all entities to assure that pollution prevention and pollutant reduction credits are recognized in an equitable manner.

34. We encourage municipalities to share resources and participate. The smaller agencies can participate through their membership in the Bay Area Stormwater Management Agencies Association (BASMAA), which is a collection of large and small agencies, and by contributing to the RMP and the Clean Estuary Partnership (CEP). Contributions to these programs are weighted based on facility size and population density. We support letting the BASMAA agencies set their own criteria for determining relative contributions.

35. Dischargers are responsible for addressing scientific uncertainties that relate to the impact of their discharge on receiving waters. We are intentionally clarifying this requirement yet not specifying the manner of compliance. This flexible approach allows dischargers to participate in the process of developing effective ways of achieving this goal. Continued RMP and CEP participation is one way for dischargers to fulfill at least part of this obligation. However, addressing these uncertainties is a broad objective that may go beyond these efforts.

36. We will make this editorial change.

37. We will refer to the appropriate section in a manner consistent with other cross references provided throughout the report.

38. In the wastewater portion of Section 4, Source Assessment, we define advanced treatment as additional solids removal. When we analyzed the performance of publicly owned wastewater treatment plants, we noticed that the performance of the plants with advanced treatment (filtration) was significantly better than those without, so we separated them out when we determined the performance-based effluent trigger concentrations. We are working closely with US EPA to develop specific permit language, including effluent limits, that meets Clean Water Act requirements.

39. The mercury allocation for refineries is for treated process waste generated by processing crude oil, which contains mercury. If refineries wish to research how much of their mercury load is due to atmospheric deposition, we will consider this information during the 5-year review. As with all NPDES permits, they will nonetheless still need to meet the requirements of the Clean Water Act.

40. We will make this editorial change.

41. Where we can, we will substitute the literature citation provided in place of the citation to a personal communication.

42. We mention salinity as a controlling factor under the "Types of Wetlands" category in Section 8, Implementation Plan. We believe this sufficiently conveys the notion that salinity may be a factor in determining the potential for methylation.

43. The Water Board participates on the RMP steering committee and technical committee and will work within this framework to design a monitoring program that meets the needs of this TMDL. Since it often takes over a year for the fish monitoring data to be evaluated, assessed, and published, the three-year monitoring interval allows us adequate time to review these results and incorporate findings on a five-year time frame.

44. While RMP scientists catch fish from a boat, they use otter trowels and gill nets and take samples from shallow areas very close to piers frequently used by sport fishers. This monitoring program was intentionally designed to evaluate pollutant levels in sportfish and associated risks to fish consumers. Every effort is made to catch and analyze the following: (1) fish from areas where fish are commonly caught, (2) fish species that are commonly consumed, and (3) fish within a size range commonly caught and consumed.

45. We prefer not to specify the normality test to be used. It is possible that no transformation will result in a normal distribution that passes a statistical hypothesis test for normality with a reasonable alpha value (0.05 or 0.10). The text suggests that the data analyst should perform the best possible transformation. However, we will change the text to indicate that the data should be transformed as close as possible to a normal distribution and that the results should be verified using a statistical normality test.

46. We purposefully chose a stringent threshold for bird egg concentrations because of the need to protect rare and endangered species. If the intent were only to protect wildlife, we may have selected a lower percentile. For example, water quality objectives are determined from a statistical approach that aims to protect the species at the 95th percentile of sensitivity. In other words, species that are more sensitive than this 95th percentile species may not be protected. However, this approach is not suitable in the case of rare and endangered species. Targets must be set and implemented such that rare and endangered species are protected. Because we have information that 0.5 ppm is a concentration of mercury that may be harmful to endangered bird species (see Section 5, Numeric Targets), we must set the threshold fairly stringently at that concentration, irrespective of any variability in bird egg concentrations.

47. We recognize that water and sediment entering San Francisco Bay from different locations likely have different residence times and that there is a need to better understand the hydrodynamics and sediment transport in San Francisco Bay. We will mention this in the appropriate section of the report under adaptive implementation.

48. Section 5, Numeric Targets, explains the rationale for stating that the target is "less than 0.5 ppm." As stated there, research is needed to determine a bird egg mercury concentration that corresponds to no adverse effects. Because available information

suggests that the bird egg mercury concentration at which no adverse effects would occur is below 0.5 ppm, a target of "less than 0.5 ppm" is proposed. To refine this target, we need a mercury toxicity threshold for the California least tern. As explained in Section 8, Implementation Plan, the U.S. Fish and Wildlife Service is conducting field and laboratory studies to determine how mercury affects bird egg development. Consistent with our adaptive management strategy, we will incorporate any new information that becomes available and, if necessary, adjust the numeric target or the species used to evaluate the target. We will revise the text to clarify that the appropriate concentration below 0.5 ppm is currently unknown.

49. We will make this editorial change.

50. We will revise the text to clarify that $45 million is spent annually.

51. The economic analysis is intended to satisfy the California Environmental Quality Act requirement that, prior to approving the Basin Plan Amendment, the Water Board conduct an environmental analysis of reasonably foreseeable methods of compliance with the proposed TMDL targets, allocations, and implementation plan. The analysis must take into account a reasonable range of factors, including economics. A similar economic analysis would be needed to support any future Basin Plan Amendment found necessary through the adaptive implementation process. As a legal requirement for future Basin Plan Amendments, the collection of economic information need not be included specifically within the adaptive management framework. Nonetheless, we will add measures to Section 8, Implementation Plan, to invite dischargers to track implementation costs so we can consider them in the future as we review TMDL implementation.

PROF. RHEA WILLIAMSON

We organized our responses to Prof. Williamson's comments by using the same identifiers as she used in her comments (e.g., page and paragraph number). These identifiers refer to the October 2003 version of the draft Basin Plan Amendment and staff report.

General Comments

The general comments and brief responses to the questions we put to the scientific peer reviewers do not require responses and are summarized at the beginning of this document. The brief responses do not include supporting information or rationales. Instead, they introduce and summarize comments listed individually elsewhere in the correspondence. Responses to these specific comments are provided below.

Specific Comments

Page 9, Figure 2.2

We will add the numeric values of the two extreme concentrations to the note. Removing these two extreme values from the figure allows the reader to see how most values (463 out of 465) compare to relevant reference concentrations (the California Toxics Rule and Basin Plan objectives).

The fact that mercury concentrations in Lower South San Francisco Bay are often higher than in many other parts of San Francisco Bay does not necessarily mean that we could better address the problem by segregating the various bay segments and developing separate TMDLs. If individual TMDLs were developed, the numeric targets would likely be the same because the same beneficial uses would need to be protected. Similarly, because many of the proposed allocations are derived from the sediment targets, the allocations would be the same. (The sediment target is concentration-based and will drive larger reductions in areas with elevated mercury concentrations than in those with lower concentrations.) If we segmented San Francisco Bay for this TMDL, the analysis would be more complicated because the bed erosion, storm water runoff, atmospheric deposition, and wastewater loads would need to be broken out by bay segment. Moreover, we would need to quantify the sediment and mercury exchange between segments, and we have no information in this area. Given the available information, this more complicated analysis would not affect the TMDL implementation plan. The adaptive implementation plan described in Section 8, Implementation Plan, provides the ability to refine this TMDL on a segment-by-segment basis if new findings emerge that suggest that a change in course is warranted. Because we are continuing our approach of treating San Francisco Bay as a whole, we see no need to provide a summary table that shows data by bay segment.

Page 12, Paragraph 5

We consistently assumed the depth of the active layer (where sediment is well mixed) to be 0.15 meters. References to 1.3 meters and 0.7 meters do not refer to the active layer. They describe the depth of buried sediment containing elevated mercury concentrations. We could have assumed a different active layer depth for analysis purposes, but the one-box model would remain a useful tool in understanding sediment and mercury transport processes in San Francisco Bay. We will revise the text for clarity.

Page 14, Figure 3.2

The analysis addresses sediment transport and mercury sources and losses associated with sediment. The net losses associated with removal of fish from San Francisco Bay and uptake by fish and wildlife are assumed to be minimal in terms of the overall mass balance. Because fish live within the bay (perhaps swimming out but later returning), uptake by fish is not a significant source or loss. Fishing does remove mercury from the bay. The staff report indicates that about 170,000 Bay Area individuals engage in sport fishing. If each were to consume 32 grams of fish per day (a conservative assumption) and the fish were to contain an average mercury concentration of about 0.4 ppm (the current mean for striped bass), then less than 1.0 kilogram of mercury would be lost to fishing each year. We have no information from which to estimate the potential loss due to wildlife uptake (we do not know the masses of Bay Area wildlife nor the mercury concentrations associated with this wildlife), but we believe it is negligible. In any case, ignoring these losses does not substantially affect the analysis. If anything, our approach results in slightly overstating the time it could take for San Francisco Bay to meet the proposed targets. We have accounted for adsorption onto surfaces through our recognition that the large majority of mercury molecules in the system will be adsorbed onto sediment particles, and we have included a suspended sediment target in our TMDL.

Page 16, Table 4.1
We estimated bed erosion for San Pablo Bay and Suisun Bay and assumed it to be negligible for all other San Francisco Bay segments, as explained in the text. Table 4.1 is intended to summarize all sources and losses discussed throughout Section 4, Source Assessment. We prefer not to include the many assumptions used to generate the table among the notes. These assumptions are included in the text.

The estimated mercury load for the Central Valley Watershed is 440 kg/yr, not 416 kg/yr. As explained in the note at the bottom of Table 4.1, we rounded most values in the table to two significant digits, but all calculations were completed prior to rounding. Therefore, the table's estimated mercury loads do not necessarily equal the product of the sediment loads and mercury concentrations listed in the table. The value of 440 kg/yr is rounded from 435 kg/yr, the value stated in the cited reference. The estimated Central Valley sediment load is 1,650 M kg/yr, which is rounded in the table to 1,600 M kg/yr. Using Equation 1, the estimated sediment mercury concentration is 0.264 ppm, which we rounded to 0.26 ppm. Rounding these values avoids implying an inappropriate level of certainty in our estimates.

Page 17, Paragraphs 2-3
By definition, the concentration of mercury in the well-mixed active layer is assumed to equal the concentration of mercury in all San Francisco Bay sediment. This concentration is not, however, the same as the mercury concentration in the eroding sediment buried below the active layer. The eroding sediment contains higher mercury concentrations. Based on the limited available data, the elevated mercury concentrations reach depths of about 0.9 meters in Grizzly Bay and about 1.3 meters in San Pablo Bay (see Figure 4.2). Therefore, we chose to estimate the depth-weighted mercury concentration in the top 1.3 meters of buried sediment because this sediment is likely to be exposed through erosion. If we included only the top 0.9 meters, the depth-weighted average would have been higher (0.50 ppm instead of 0.42 ppm). This difference results in a higher total mercury load to San Francisco Bay for a shorter time period, and slightly increases the predicted recovery time.

We did not use Grizzly Bay and San Pablo Bay data to represent bed erosion for other bay segments. We assumed that net burial or erosion from the other segments is negligible because the greatest erosion would be expected to occur along the edges of channels and the Central Valley watershed flows running through Suisun Bay and San Pablo Bay are far greater than the local tributary flows running through Lower San Francisco Bay and South San Francisco Bay. We have insufficient information on which to base a more reasonable assumption, but efforts are underway at the USGS to study erosion and deposition in other parts of San Francisco Bay.

Page 18, Paragraph 1

We reported available information, which includes Triangle Marsh mercury concentrations only at depths greater than 0.7 meters. Mercury concentrations may be higher or lower at shallower depths, but since Triangle Marsh is stable, bed erosion is not an issue. We did not rely on the Triangle Marsh data for our bed erosion load estimate because mercury concentrations were not reported for the shallower depths, the core was taken from a depositional environment, and Triangle Marsh is located far from Suisun Bay and San Pablo Bay, where most bed erosion is assumed to occur. Since we did not rely on the Triangle Marsh data for our bed erosion load estimate, it is unnecessary to further characterize the development of the marsh.

Page 19, Paragraph 1

As stated on page 17, mercury loads for other bay segments are assumed to be negligible; therefore, the net sediment loss of 1,100 M kg/yr represents our best estimate for all of San Francisco Bay. As indicated above, information is insufficient to derive any other estimate of bed erosion for other bay segments. As explained above, we assumed that net burial or erosion from the other segments is negligible because the greatest erosion would be expected to occur along the edges of channels and the Central Valley watershed flows running through Suisun Bay and San Pablo Bay are far greater than the local tributary flows running through Lower San Francisco Bay and South San Francisco Bay.

Page 19, Paragraph 3

As discussed above, the cited reference estimates the Central Valley watershed load to be 435 kg/yr, which we rounded to 440 kg/yr for purposes of our report.

Page 19, Paragraph 4

Paragraph 3 states that the estimated Central Valley mercury load is about 440 kg/yr, which could be as much as 100 kg/yr over or under the actual load. Paragraph 4 refers to a specific circumstance that could result in the estimate being an overstatement.

Page 20, Paragraph 3

We recognize that agricultural activities may discharge contaminants to surface waters. However, we did not omit agricultural runoff from the source assessment. Throughout the San Francisco Bay watershed, most agricultural activity by far occurs in the Central Valley, and to the extent that agricultural activities are mercury sources, the resulting loads are included within the Central Valley watershed load. We estimated sediment mercury concentrations for the Central Valley watershed using actual sediment measurements.

The amount of agriculture occurring within San Francisco Bay's local tributary watershed is relatively small, even when not considering the Central Valley. The method used to calculate storm water runoff loads assumes that agricultural land use represents just 11% of all local watershed land uses (compared to 43% for open space). We are unaware of any measurements of mercury concentrations in water or sediment strictly from local agricultural areas. Faced with this information gap, we assumed that agricultural runoff from these relatively small areas would be similar to open space runoff. As the TMDL is implemented, the urban runoff management agencies will monitor mercury concentrations in local tributaries, and because these agencies have an interest in ensuring that they take responsibility for their own urban discharges and not open space or agricultural discharges, their monitoring would identify upstream agricultural loads if our assumption were incorrect. We would address this unlikely scenario through adaptive management.

Page 21, Bullet 2

We agree that agricultural practices can result in sediment runoff. To estimate the total sediment load from local tributaries, we relied on a USGS estimate, which included sediment from all sources, including agriculture. To estimate the fraction of the total sediment load attributable to urban and non-urban storm water runoff, we used rainfall data and approximate runoff fractions, typical sediment concentrations, and estimated area covered by land use, including residential, commercial, industrial, *agricultural*, and open space land uses. We placed agricultural land use in the non-urban category because, as discussed in the response above (Page 20, Paragraph 3), we assumed that the mercury concentration in agricultural sediment is more similar to that of open space than that of urban land uses.

Page 23, Paragraph 3

Our report states that the method the urban runoff management agencies used to estimate storm water runoff loads might underestimate true loads by a factor of 2 to 3. We did not use their estimate, however. Instead, we relied on USGS data to estimate the sediment load. Nevertheless, the USGS data do not distinguish sediment loads from urban and non-urban areas, and we wanted to distinguish the loads from these sources. Therefore, we used the urban runoff management agency approach to estimate the ratio of urban to non-urban sediment loads—not the absolute loads. (Although the urban runoff management agency approach may underestimate absolute loads, we assumed that this method would reasonably estimate the ratio of the urban to non-urban sediment loads.) We will revise the text for clarity. To avoid confusion, we will delete our statement about potentially overstating the storm water sediment load.

Page 24, Paragraph 1

To estimate the atmospheric deposition load we relied on a recent SFEI study that entailed measuring wet and dry mercury deposition in the Bay Area. The findings take into consideration effective fog deposition.

Page 25, Paragraph 3

The paragraph at issue appears under the heading “Wastewater”; therefore, it focuses on industrial wastewater loads. Other industrial mercury releases (e.g., to the atmosphere) may result in loads to San Francisco Bay, but these indirect sources are accounted for in other categories, such as atmospheric deposition and storm water runoff loads. Our assessment of industrial mercury discharges is based on effluent monitoring data, and we included these data and calculations supporting our load estimate among the cited references. As for Central Valley wastewater discharges, they are included in the Central Valley watershed load estimate.

Page 27, Paragraph 2

We based our sediment dredging and disposal estimates on available information, including the *Long-Term Management Strategy for the Placement of Dredged Material in the San Francisco Bay Region, Management Plan 2001*, which contains in-bay dredged material disposal volumes for the period from 1991 through 1999. Dredged material disposal varies substantially from year to year, and basing our load estimate on nine years of data reflects this variability well. However, equivalent data are unavailable for out-of-bay disposal. Out-of-bay disposal records prior to 1999 are unreliable. Therefore, we based our out-of-bay disposal estimate on three years of data, 1999 through 2001. All these data represent the period before the LTMS was adopted. As shown in the table below, including the 2000 and 2001 in-bay disposal volumes in the calculations does not substantially change the result (supporting documentation for the 2000 and 2001 data is attached to this response memorandum). Moreover, including this information would not affect the proposed allocations or implementation plan.

In-Bay Dredged Material Disposal Volumes, 1991-2001

		1991-1999		1991-2001	
Year	**Volume (yd^3)**	**Mean**	**Median**	**Mean**	**Median**
1991	2,200,000				
1992	1,990,000				
1993	3,290,000				
1994	2,600,000				
1995	2,180,000	2,350,000	2,180,000		
1996	2,790,000			2,190,000	2,190,000
1997	1,730,000				
1998	1,930,000				
1999	2,430,000				
2000	880,000				
2001	2,040,000				

Page 28, Table 4.5
The dates for the data used to estimate dredged materials volumes, sediment masses, and mercury loads appear in the text.

Page 28, Paragraph 1 and (*) in Table 4.5
We used different units to describe bay sediment volumes and dredged sediment volumes because our information sources used different units. Readers comparing our report to the cited references may be unnecessarily confused if we change the units to be consistent with a single conversion factor, which can just as easily be expressed in alternative units.

Page 28, Paragraph 2
Because we estimated mercury concentrations in dredged sediment disposed of in-bay (a source) using actual concentrations measured in sediment disposed of in-bay, our estimate is reasonable. Dredged sediment disposed of out-of-bay may contain higher mercury concentrations, but this would have little effect on our analysis. To the extent that we may have understated the mercury load for dredged sediment disposed of out-of-bay, we may have understated total mercury losses. The result is that we may have overstated the estimated recovery time.

Page 28, Paragraph 3
The basis for questioning our Golden Gate estimate is unclear. We acknowledge that this estimate is based on a number of other estimates and the steady-state one-box model described in Section 3, Mass Budget Approach. As discussed in an above response, uptake by wildlife and

fish is not expected to substantially affect this relatively large mercury loss. Moreover, as we stated in the report, our estimate is within the range of other estimates.

Page 29, Paragraph 2

As shown in Table 4.1, mercury exits San Francisco Bay through evaporation, dredging and disposal and transport through the Golden Gate. The sum of these losses is about 1,730 kg/yr. Since transport through the Golden Gate represents about 1,400 kg/yr, it is about 81% of the total mercury leaving the bay through these routes. We will modify the text for clarity.

Page 29, Paragraph 4

The text does not say that Section 7, Allocations, will directly address mines. It says the margin of safety described there is intended to account for the potential that we have not identified some minor mercury sources. As for the implementation plan, we are not required to propose implementation measures for sources we have not identified (some mines could potentially be sources, but we do not have any information confirming this). The measures in the implementation plan are intended to describe how we will identify whether any mine is actually a mercury source and, if so, how we will address this source. These key provisions are already part of the Basin Plan; therefore, they should be implemented immediately. We will add a timeline to the Implementation Plan text that expresses our expectation of progress on these actions.

Page 30, Paragraph 1

We will remove the word "of" from the sentence.

Page 30, Paragraph 1

The text does not say that Section 7, Allocations, will directly address bay margin sites. It says the margin of safety described there is intended to account for the potential that we have not identified some minor mercury sources. As for the implementation plan, we are not required to propose implementation measures for sources we have not identified (some bay margin sites could potentially be sources, but we do not have any information confirming this). The measures in the implementation plan are intended to describe how we will identify whether any bay margin site is actually a mercury source and, if so, how we will address this source. These key provisions are already part of the Basin Plan; therefore, they should be implemented immediately. We will add a timeline to the Implementation Plan text that expresses our expectation of progress on these actions.

Page 33, Paragraph 2

The fish consumption value of 0.032 kilograms per day is conservative and based on an actual survey of people who consume San Francisco Bay fish. Of this population, 95% consume less than 0.032 kilograms per day. This consumption rate is greater than the default value USEPA used (0.0175 kilograms per day) in developing its mercury fish tissue criterion. We are unaware of any evidence suggesting that this value is low and that the fish tissue target is not protective.

Page 35, Paragraphs 2-3
The lowest bird egg mercury concentration at which adverse effects have been reported (LOEC) is 0.5 ppm. We have not proposed that the bird egg target be *any* value less than 0.5 ppm. We have proposed that it should be *some* value less than 0.5 ppm to be determined when adequate information is available. Available data are insufficient for us to determine what this value should be. The U.S. Fish and Wildlife Service (USFWS), in its review of USEPA's fish tissue residue criterion, addresses the same lack of information by suggesting that 0.5 ppm be divided by 2 or 3 to estimate a no-effects concentration (NOEC). NOEC and LOEC values can only be determined by experiment. Typically, a range of exposure concentrations is tested and the resulting effects are observed. The NOEC is the highest concentration that does not result in an effect. The LOEC is the lowest concentration that does result in an effect. The difference between the LOEC and NOEC depends on the intervals between the tested concentrations. As more concentrations are tested at smaller intervals, the NOEC and LOEC tend to converge on a value where adverse effects actually begin to occur. USFWS's approach of dividing the LOEC by 2 or 3 is based on the typical intervals between concentrations tested during experiments, which is a practical result of the experimental design, not an intrinsic toxicological property. We prefer to wait for a more scientifically defensible NOEC to be determined before formally establishing a concentration-specific wildlife target in our Basin Plan.

The lack of a NOEC does not affect our ability to drive reductions to levels that are likely to protect wildlife, and the adaptive implementation plan in Section 8, Implementation Plan, enables us to modify the wildlife target when appropriate. The proposed sediment mercury concentration target calls for a 50% reduction, far more than would be needed to reduce least tern egg mercury concentrations to 0.5 ppm. The 50% reduction would reduce least tern egg mercury concentrations to about 0.33 ppm, below the 0.5 ppm LOEC and within the range proposed by USFWS. Therefore, a more precise bird egg target is unnecessary in the short term.

Page 35, Paragraph 4
The cited reference included the mean and range of mercury concentrations for 17 California least tern eggs collected in the northern portion of San Francisco Bay. A 25% reduction would reduce the average concentration from 0.66 ppm to 0.50 ppm. However, the sediment target and the allocations derived from the sediment target are based on a 50% reduction. A 50% reduction in the average least tern egg mercury concentration would be about 0.33 ppm, well below the 0.5 ppm target.

Page 36, Equation 4
We will clarify the text by adding units to Equation 4.

Page 36, Paragraphs 3-4
We rounded the reported suspended sediment mercury concentrations. The median concentration is 0.333 milligrams mercury per kilogram dry sediment (ppm). A 50% reduction is 0.167 milligrams per kilogram, which rounds to about 0.2 ppm. We agree that some bay

segments will need greater decreases in mercury concentrations than others to meet this target. To ensure that mercury loads are adequately reduced in all areas, we based most of our allocations on the target of 0.2 ppm, even where existing mercury concentrations are elevated compared to the rest of San Francisco Bay. The result is that greater reductions are needed to reach the allocations in these areas. We will revise the text for clarity.

Page 37, Paragraph 1 beginning below the bullets
To derive the water criterion of 0.025 microgram per liter (parts per billion), USEPA used a bioconcentration factor of 40,000 obtained from tests with the Eastern oyster.
A bioconcentration factor relates the concentration in an organism to the concentration in the water in which the organism lives. The USDA action level of 1 ppm mercury in fish divided by the bioconcentration factor is 0.000025 ppm, or 0.025 parts per billion. We will revise the text for clarity.

Page 37, Paragraph 2 beginning below the bullets
On the basis of existing information, we cannot know whether the California least tern is endangered due to mercury, habitat destruction, or other factors. Nevertheless, we must ensure that the TMDL seeks to protect the California least tern from mercury exposure. We will revise the text to clarify that at some unknown concentration below 0.5 ppm detrimental effects would be unlikely. An above response (Page 35, Paragraphs 2-3) explains our rationale for not dividing the LOEC of 0.5 ppm by a factor of 2 or 3.

Page 38, Figure 5.2
See response above (Page 9, Figure 2.2).

Page 39, Figure 5.3
We labeled the x-axis incorrectly. The x-axis corresponds to 384 15-minute periods making up a four-day window, not 384 minutes as the label suggests. We will correct the label.

Page 43, Paragraph 3
Without additional information about methylation rates in different parts of San Francisco Bay, we cannot offer an alternative analysis. The sediment target of 0.2 ppm applies to all portions of San Francisco Bay, not just the bay as a whole. In addition to reducing loads, the adaptive implementation plan described in Section 8, Implementation Plan, requires actions to identify methylation-controlling factors and minimize methylation.

Page 45, Paragraph 4
With a number of assumptions, we have provided our best estimate for the total mass of mercury in the active layer, which we defined for purposes of our report to include the top 0.15 meters of the bay floor. We are not required to provide a conservative estimate, and in this context, it’s unclear whether “conservative” means estimating a higher or lower mercury mass because this mass was not used to derive the targets or allocations. We recognize that the depth of the active sediment layer and the concentration of mercury within it vary throughout the bay. On pages 81

and 82 of the report, we discuss the need for models that better account for the depth of the active layer.

Page 47, Last Paragraph
We agree that a number of factors affect methylmercury production. We discussed these factors in Section 6, Linkage Analysis.

Page 48, Table 7.1
We will add a column showing the percent reductions from 2003 loads represented by the allocations.

Page 49, Paragraph 2
Maintenance dredging occurs where new sediment is building up and needs to be removed. It likely does not affect the potential for widespread bed erosion. To the extent that dredged material is disposed of in San Francisco Bay, a bit could disperse and inhibit erosion. However, the volume of dredged sediment is relatively small compared with the volumes of sediment moving around the bay due to natural processes.

Page 49, Paragraph 3
We have no information that leads us to believe that the Central Valley watershed load cannot be reduced from 440 kg/yr to 330 kg/yr (a 24% reduction). Actions necessary to reduce the Central Valley watershed load are summarized in Section 8, Implementation Plan. The sediment load is consistent throughout the report. On pages 16 and 19, it is rounded. We will revise the text on page 49 to reflect the rounded value of 1,600 M Kg/yr.

Page 50, Paragraph 3
We cannot tell from this comment what additional information is desired regarding the rationale for the Guadalupe River watershed mining legacy allocation. Other Bay Area mines are addressed on page 55. Because available information is insufficient to confirm that other mines are sources, we have provided no allocation.

Page 50, Paragraph 4
Section 8, Implementation Plan, discusses potential implementation actions related to atmospheric deposition.

Page 52, Paragraph 1
See response above (Page 20, Paragraph 3A). Any irrigation return flows are included in the Central Valley watershed load, but agriculture is believed to be an inconsequential contributor.

Page 55, Paragraph 2
Table 4.7 confirms that mercury exists at some bay margin sites, but this does not mean that substantial amounts of mercury are leaving these sites and entering San Francisco Bay.

Page 55, Number 1
We used data from Grizzly Bay to represent conditions in Suisun Bay because the Grizzly Bay site is the site closest to Suisun Bay for which data are available. Regarding the depth of the sediment cores, refer to our response above (Page 12, Paragraph 5). Averaging the data from the Grizzly Bay and San Pablo Bay cores is reasonable because few data are available and it is unclear whether conditions in San Pablo Bay and Suisun Bay differ substantially.

We estimated how long bed erosion would continue on the basis of available information, consistent with the assumptions used throughout the report. We acknowledge that our estimate is uncertain and that other estimates are possible. We cannot tell from the comment how this should be addressed through the margin of safety.

We will revise the citation to refer to Figure 4.2, not Figure 4.3.

Page 56, Paragraph 2
The loads considered in this scenario are consistent with the proposed allocations, which are summarized in Table 7.1.

Page 57, Bullet 3
Small fish, such as anchovy and herring, do not typically accumulate mercury at concentrations as high as large fish. The California Office of Environmental Health Hazard Assessment's fish advisory does not list these small fish. The RMP's fish monitoring program collects and analyzes the most commonly caught and consumed fish. Anchovy and herring have not been identified as posing a potential risk to consumers. Sport fishers prefer to catch and consume large fish, like striped bass. Therefore, the proposed fish tissue target applies to the relatively large fish human consumers prefer. In this particular instance, the target of 0.2 ppm is comparable to USEPA's value of 0.35 ppm.

Page 58, Bullet 3
The adaptive management plan described in Section 8, Implementation Plan, calls for TMDL implementation to respond to new information as it becomes available. We are unaware of any studies that suggest that mercury mines outside the Guadalupe River watershed or bay margin contaminated sites are sources of mercury to San Francisco Bay. Tables 4.6 and 4.7 do not contain mercury loads. Table 4.6 does not include any quantitative data, and Table 4.7 provides only a rough estimate of the possible mass of mercury at various sites. It says nothing about how much of the mercury could be entering San Francisco Bay. Technical studies, while not directly influencing the amount of mercury that gets into the bay, are, in fact, implementation measures. Our implementation plan calls not only for action directed at reducing sources, but also calls for information gathering to inform future decision-making.

Page 59, Paragraphs 1-2
This comment does not provide any additional information to support the discussion of seasonal variability and critical conditions. We believe that the quantitative information we present along

with the accompanying discussion is adequate. It explains that the nature of the San Francisco Bay mercury problem is not seasonal and our TMDL approach accounts for any critical conditions. Figure 5.3 illustrates that suspended sediment concentrations do fluctuate according to a twice-daily cycle. While this affects the total mercury concentration in the water column, it does not demonstrate a seasonal effect. We have added Figure 7.3 to illustrate that there is no apparent seasonal trend in water column total mercury concentrations despite presumed seasonal variability in total mercury loading. Moreover, effects on the beneficial uses of sport fishing, wildlife, and rare and endangered species protection do not appear to vary with season or other critical conditions.

Page 60, Paragraph 5
Implementing this TMDL in a manner that addressed multiple pollutants as efficiently as possible is sound policy and within our authority.

Page 62, Box
This box and others like it are intended to serve as convenient summaries. They are not intended to recount all proposed actions. We included all the actions we propose to require in the draft Basin Plan Amendment. These actions include means to address bioavailability and feasibility of reducing biological uptake.

Page 62, Paragraph 4
The TMDL requires urban storm water runoff agencies to meet allocations. It does not require a trading program, but it expresses our openness to developing one in certain circumstances if a need and desire materialize. No specific trading has been proposed; therefore, speculation regarding how trades might be negotiated is premature. Any program would need to be consistent with the proposed allocations for all source categories, including the Central Valley watershed and wastewater, and meet water quality standards and protect beneficial uses.

Page 66, Paragraph 2
Table 8.1 provides all the relevant values. Presenting percentages is intended to help the reader more quickly interpret the data. The information we provided supports our conclusions.

Page 66, Paragraph 4
Comparing crematoria emissions to the atmospheric deposition load is inappropriate. We do not know what fraction of crematoria emissions deposit within the San Francisco Bay watershed versus the fraction that enters the global mercury cycle. Moreover, we do not know what fraction of the mercury deposited in the watershed actually runs off into San Francisco Bay. Because most of the mercury in crematoria emissions comes from amalgam fillings as fewer amalgam fillings are placed, fewer amalgam fillings will be cremated, and less mercury will be released. We recognize that this trend may take some time to materialize.

Page 69, Bullets 3-4
We included these same requirements among those for industrial dischargers. Municipal and industrial wastewater facilities are free to collaborate, but as a matter of policy, not science, we do not believe we should require collaboration.

Page 70, Bullet 2
See response above (Page 69, Bullets 3-4).

Page 71, Bullet 1
See response above (Page 69, Bullets 3-4).

Page 71, Bottom of Page
Determining the fate of crude oil mercury (item 2) will involve determining how much mercury is emitted to air.

Page 72, Paragraph 3
We will add a timeline for these actions.

Page 73, Paragraph 2 below the numbered actions
We will add a timeline for these actions.

Page 75, Paragraph 2
We expect dredging operations to be consistent with the LTMS, and through our existing authorities, we will require that mercury concentrations in sediment disposed of in San Francisco Bay not exceed baywide ambient conditions. We will also require studies to better understand how dredging operations affect mercury fate, transport, and biological uptake. Consistent with our approach for other source categories, we prefer to allow the dredging community the flexibility to determine for itself how the allocations and other requirements will be met.

Page 77, Paragraph 2
We will revise the text to clarify that pollution trading will not exchange Bay Area mercury loads for mercury reductions outside of the San Francisco Bay watershed. Although we propose to leave it to mercury dischargers to development trading proposals, if any, we will not relinquish our authority to approve any trading schemes.

Page 78, Evaluation of Fish Tissue Target
The linear relationship between mercury concentration and fish length is well established for striped bass, as cited in the report. We propose to collect both small and medium striped bass to ensure that we have fish tissue data on both sides of the 60 centimeter (cm) length we propose to use for comparisons with the fish tissue target. Fish of this size are probably typical of those eaten since fish greater than 82 cm are rarely caught. Existing data suggest that striped bass measuring 60 cm currently have an average mercury concentration of 0.4 ppm; therefore, a 50%

reduction will attain the proposed target of 0.2 ppm. We will continue to work with the RMP to ensure that the samples collected are sufficient to meet our trend analysis needs.

Page 82, Bullet 1
We acknowledge that the active layer depth can vary, but we do not have detailed information describing the depth within different part of San Francisco Bay. Our assumption is reasonable and adequate for purposes of our calculations, and the comment does not offer an alternative assumption.

Page 84, Paragraph 1
The TMDL is intended to protect the beneficial use of sport fishing and human fish consumption. About 78% of the individuals who consume bay fish report consuming striped bass. Monitoring striped bass mercury concentrations is a good measure of beneficial use protection. We acknowledge that striped bass spend portions of their lives outside San Francisco Bay, which complicates the linkage between striped bass mercury concentrations and the proposed fish tissue target (see Section 6, Linkage Analysis). However, evaluating an alternative species, which is consumed less often, could be of little value if we were to show that the fish tissue target is met in the alternative fish but striped bass are still unsafe to eat. Likewise, little would be gained in evaluating a fish species that is already below the target.

Page 103
We will correct the spelling of "San Francisco."

Page A-2, Second set of bullets
We included Castro Cove, Oakland Inner Harbor, and San Leandro Bay within our definition of San Francisco Bay on page 4. We do not have a compelling reason to segregate these areas from the rest of San Francisco Bay. We would propose the same numeric targets because the same beneficial uses would need to be protected. Similarly, allocations would be the same. The sediment target is concentration-based and will drive larger reductions in areas with elevated mercury concentrations than in those with lower concentrations. The adaptive implementation plan described in Section 8, Implementation Plan, provides the ability to refine actions for these areas if new findings emerge that suggest that a change in course is warranted.

Page A-3, Top of page
See response above (Page 78, Evaluation of Fish Tissue Target).

PROF. JAMES KIRCHNER

We organized our responses to Prof. Kirchner's comments by referring to the same alphanumeric identifiers he used in his comments, which match those of our original questions.

1a. We will remove the word "annually" from the Figure 2.2 caption. Data have been collected since 2000, but there is a lag between when data are collected and when data are available. We included all the data available when the figure was created.

RMP data are available at www.sfei.org/rmp/data.htm. Data for 2001 did not become available until recently, and some data are still undergoing a quality assurance review. The summary statistics of key parameters with and without the 2001 data show that none of our conclusions would change if we were to include them (see table below). Therefore, we are not planning to change our text to incorporate the 2001 data at this late stage in the process.

Regional Monitoring Program Data With and Without 2001 Data

	1993-2000		1993-2001	
	Mean (N)	**Median**	**Mean (N)**	**Median**
Total Hg in Water Column (µg/l)	0.0216 (465)	0.0095	0.0217 (490)	0.0096
Suspended Sediment Hg Concentration (mg/kg)	0.4388 (465)	0.3330	0.4421 (478)	0.3342
Bed Sediment Hg Concentration, normalized to fine fraction (mg/kg)	0.4128 (365)	0.3742	0.4109 (394)	0.3737

N = number of samples

2a. We will revise the text to clarify that there are two models, one for sediment and one for mercury. We apply the steady-state assumption to the water column plus the active layer, which we defined for purposes of the report to be 0.15 meters deep. Since the active layer is defined to be a fixed depth, the volume of sediment in the active layer is constant. As sediment erodes or is buried, the active layer shifts up or down. We will revise the text for clarity. We will also clarify the extent to which the steady-state assumption can be used to estimate missing information.

2b. This general comment does not require a response.

3a. We will clarify the text to distinguish what we mean by storm water runoff and mine-related runoff.

3b. We will delete the sentence from page 29 because it causes unnecessary confusion. On page 30, we will delete the word "of."

3c. We agree that uncertainties are relatively large in some cases. We address these uncertainties through our implicit margin of safety and our proposed adaptive implementation plan.

4a. We will revise the figure illustrating the fish tissue data and include the mean. The percent reduction needed to meet the target is unchanged.

Adverse effects have been observed when bird egg mercury concentrations are 0.5 ppm and higher. Our sentence about detrimental effects being unlikely below 0.5 ppm is a misstatement. We will revise the sentence to clarify that at some unknown concentration below 0.5 ppm, detrimental effects would be unlikely.

5a. According to the cited reference (USGS 2003b), mercury loads (as reflected by total sediment mercury concentrations) have a logarithmic effect on methylation. Methylmercury production appears proportional to total sediment mercury concentrations at low concentrations, but at high concentrations, little additional methylmercury is produced with additional total mercury in the sediment.

5b. To avoid a scenario where factors controlling methylation change and the proposed load allocations are no longer adequate, Section 8, Implementation Plan, includes actions specifically aimed at identifying methylation controlling factors and minimizing methylation.

5c. As a result of assuming that the rate of mercury elimination is linearly related to fish concentrations, the model SFEI is developing predicts that striped bass mercury concentrations will level off after three or four years. Striped bass mercury concentrations are known to be directly proportional to fish length. As a striped bass ages, its growth levels off and increases in its length decline. Therefore, fish tissue mercury concentrations would not be expected to increase with advanced age because the length of the fish no longer increases.

6a. This general comment does not require a response.

6b. In many cases, the sediment target was a convenient way to sensibly derive allocations. However, we did not derive all the allocations from the sediment target. In cases where the mercury source is not associated with a sediment load, this approach was infeasible, and we expressed the allocation simply as a load. We converted allocations derived from the sediment target into loads for consistency. We wanted to express the allocations as loads to have a common basis for comparisons among allocations. In implementing the allocations (see Section 8, Implementation Plan), we will consider, where appropriate, both loads and sediment concentrations in determining consistency with the allocations. We will revise the text for clarity.

6c. This general comment does not require a response.

6d. Section 8, Implementation Plan, calls for studies that explore the relative bioavailability of mercury from different sources.

6e. This general comment does not require a response.

7a. This general comment does not require a response.

7b. We agree that conservatism in the targets is not, by itself, adequate to ensure that targets and standards will be met. We will revise the text for clarity. Our intention is that, in addition to any conservative assumptions in the analysis, the adaptive management strategy provides the needed margin of safety.

8a. This general comment does not require a response.

8b. This general comment does not require a response.

8c. See response to Dr. Sedlak's comment (#43).

8d. We will add the suggested management question regarding mercury in crude oil.

8e. We will add the suggestion for employing controlled experiments.

9a. This general comment does not require a response.

9b. This general comment does not require a response.

9c. This general comment does not require a response.

Attachments:

Dredged Material Management Office 2001. “Dredged Material Management Office (DMMO) Annual Report, January 1, 2000 through December 31, 2000,” April, pp. 4-5.

Dredged Material Management Office 2002. “Dredged Material Management Office (DMMO) Annual Report, January 1, 2001 through December 31, 2001,” March, p. 3.